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ABSTRACT

There are numerous teaching suggestions to offer for guiding pupils to achieve more optimally in mathematics. There is, however, a problem involved in writing about the implementation of selected teaching suggestions: there needs to be a readiness of learning prior to implementing any teaching suggestion. If pupils cannot benefit from the teaching suggestions, the chances are they are too difficult. From then on the materials used in teaching should guide pupils to be successful in attaining new and challenging objectives. Also, the teacher needs to observe what interests a pupil in learning. This article suggests activities for teachers such as using blocks, beads, transparencies, geoboards, money, and computer software in teaching mathematics. (ASK)

Assessing Teaching Suggestions in Mathematics

by

Marlow Ediger

ASSESSING TEACHING SUGGESTIONS IN MATHEMATICS

There are numerous teaching suggestions to offer in guiding pupils to achieve more optimally in mathematics. There is a problem involved in writing about the implementation of selected teaching suggestions. Why? There needs to be readiness of learning prior to implementing any teaching suggestion. If pupils cannot benefit from the teaching suggestions, the chances are they are too difficult. These suggestions may also be too easy for some and thus not challenge the involved learner. If anything is important in teaching as a priority in mathematics, the instructor needs to begin where the pupil is presently. From then on the materials used in teaching should guide pupils to be successful in attaining new and challenging objectives. Second, the teacher needs to observe what interests the pupil in learning. There are activities that are more interesting as compared to others. I will suggest activities for teachers to use; these must be on the meaning and understanding level of the pupil to be taught.

Using Blocks in Teaching Mathematics

Friedrich Froebel (1782-1852) was an early advocate of using a hands on approach in learning for pupils. One kind of material advocated by Froebel was blocks for children. Here, pupils could manipulate these concrete materials to build model buildings, to count, to add, to subtract, to multiply, and to divide by using the blocks. What additional things might pupils do today with blocks?

1. they might be given a certain number of blocks such as sixteen. Learners then individually or collaboratively might arrange these into many different patterns, designs, and answers to questions as possible. Thus, a four by four arrangement of blocks in a box makes for sixteen as does a two by eight arrangement. Also, a two by two by four high makes an arrangement of sixteen blocks. Pupils need to experiment with a hands on approach in determining how may arrangements can be made of a given set of blocks. For example, with sixteen blocks, pupils may show a two by eight or an eight by two arrangement to show the commutative property of multiplication. Or, a two by two by four arrangement can indicate the associative property of multiplication in that the factors can be multiplied in any order and the product is still sixteen.

2. it is important for pupils to make discoveries such as in using a two by eight or an eight by two arrangement of blocks making for sixteen blocks as the product. The commutative property of multiplication is consistent here as is the commutative property of addition such as three blocks and five blocks or five blocks and three blocks make for a total of

eight blocks. The associative property of addition and multiplication, as a pattern, also needs to be discovered by involved learners. Two blocks and three blocks joined together with four blocks has the same number in value as four blocks and three blocks joined together with two blocks,. Each set has nine blocks. There can be more that three sets of blocks joined together to stress the commutative property. The associative property holds true for multiplication in that two times three times four has the same product as does four times three times two. There can be more than three sets of numbers to consider in the associative property, such as 2 times 3 times 4 times 5 equals 5 times 4 times 3 times 2. The numbers can be arranged in any order and the property of association holds true in addition and multiplication.

Attribute Blocks and Buttons

Attribute blocks may be used at the right stage of pupil development to achieve many objectives in mathematics instruction. Thus, attribute blocks may be used to count, add, subtract, multiply, and divide, as well as to sort items with definite criteria in mind. Here, we will focus upon sorting based on observable criteria, such as by color, by size, and by geometrical form. The attribute blocks may be thin such as made of plywood and contain diverse colors such as red, blue, yellow, orange, and purple. A set of learners may then sort all the reds in one pile, all the blues in another, all the yellows in a third pile, and so on.

A less exacting way of sorting is to divide the attributes into large, medium, and small sizes. A third way of sorting is to place all the squares in one pile, the rectangles into a second set, the circles into a third set, and so on.

Many teachers enjoy collecting buttons of divers kinds. When ready, pupils individually or collaboratively, may sort these buttons into those which have four holes, three holes, and two holes. Buttons may also be sorted into categories of color and of size. Children should have ample opportunities to construct their very own knowledge when planning the mathematics curriculum with the teacher.

Letting children construct their own knowledge allows teachers to reach the full range of students. Traditional methods of direct instruction, while appearing to work for some, fails to work for a large percent of students. Those who benefit little from traditional approaches include children from all achievement groups---from average students to those in special education; both these considered "slow learners" and those labeled "gifted or talented,"

All children are unique. They enter learning situations with different backgrounds. They exhibit different learning styles. They

develop in their own unique ways, and at their own pace. Consequently, each child will interpret and connect ideas differently and must construct for himself or herself the connections and relationships among those concepts essential to understanding mathematics (Rowan and Bourne, 1994).

Using Beads to Show a Pattern

Pupils may use beads and buttons to develop a pattern of materials in a design. Thus, stringing a pattern of red, yellow, blue, white, and green beads make for an interesting design and pattern. Pupils need to be encouraged in being creative in design development.
Buttons of different colors may also be used in securing a pattern on a string. Pupils need to explore different patterns when stringing beads and buttons.

There are excellent drawings which may be made showing different patterns. Thus blocks of different colors might be drawn showing the following in sequence, as an example, white, yellow, red, blue, black, and green. These are activities which most pupils find fascinating and engaging. Then too, here are ways and materials for pupils to use to perform the four basic operations on number. The commutative and associative properties of addition and multiplication may be shown to indicate understanding by learners.

Number Patterns

Many pupils are truly interested in working with abstract numbers which indicate a pattern. The following is an example:

The number of counting numbers	Addition of these counting numbers	Sum
1	1	1
2	1+3	4
3	1+3+5	9
4	1+3+5+7	16
5	1+3+5+7+9	25
6	1+3+5+7+9+11	36
7	Pupils need to complete 7-9.	
8		
9		

The background information factor is important to consider when

stressing abstract learnings for pupils. Also, the complexity of abstract numbers and numerals needs a thorough consideration. Good mathematics teachers soon realize what their pupils can and cannot achieve, in general. Perhaps, teachers need to use more challenging strategies of teaching whereby pupils may realize new heights in mathematics achievement. However, frustration on the part of pupils should not be a part of making the curriculum more challenging. After all, pupils individually need to be successful learners. Negative feelings accrue from experiencing failure on the learner's part. Quality sequence in learning whereby new learnings are directly related to those previously experienced should be in the offing.

Learning opportunities for pupils should be interesting to capture learner attention. They need to possess purpose so that pupils feel there are values in learning. Individual differences need to be provided for such as pupils of different levels of capacity and achievement must have appropriate learning opportunities. Pupils need to understand that which is taught so that meaningful learning accrues (Ediger, 1994).

Art and Geometry

Cutouts from different colors of construction paper may emphasize circles, squares, rectangles, semi-circles, triangles, and trapezoids to be used by pupils to make different animal, human, and imaginary figures. Learners tend to enjoy this activity and can be quite creative in their endeavors. They seemingly are on task continuously when engaging in geometry art. Learners need to call each geometrical figure used by name. In this way, many pupils at the early primary grade level have learned to call each figure using the correct name.

A display of each finished product in geometry art may be shown on the classroom bulletin board or on the hallway wall outside the classroom. Pupils from other classrooms observe these exhibits and in some cases have asked their teachers if the same or similar activity could be used in their classroom.

In geometry art, pupils should be able to

1. know likenesses and differences among the different geometrical figures.
2. determine the perimeter of each when readiness is in evidence.
3. compute the area of each as appropriate sequence is in evidence.
4. find uses for each geometrical figure in society.
5. add additional geometric figures to the repertoire of learning.

Kit of Markers and Place Value Charts

Each pupil needs to have a kit of markers in a bag. These markers should include corn seeds, soybean seeds, tooth picks, and short pencils. The teacher can readily determine if a young child understands what 4+5=9 by having the child at his/her desk reproduce with markers this basic addition fact. Or, the teacher may have pupils show at their desks 9-6=3 with the use of markers. "How many" when counting may also be shown such as the value of ten. The teacher may observe rather quickly if a pupil understands what is called for. If a class size is large, in particular, the teacher may scan each pupil's desk to see if responses made are correct in terms of what is called for.

The markers lend themselves very well to understanding place value when this concept is being taught. Thus, eleven seeds may be regrouped into one ten and one one. In a place value chart with pockets, the pupil may place congruent strips of construction paper in the one's column and in the ten's column. Pupils need to attach meaning to what is meant by ones, tens, hundreds, and thousands, in sequence. A chart with pockets numbered for each place value can be very helpful for pupils to understand ones, tens, and hundreds.

Counting Rules

Pupils enjoy games in mathematics. Games are a way of learning to achieve objectives. Thus, games have educational values as well as in playing for enjoyment. A game that may be played needs to fit in sequence into the ongoing lesson/unit of study pertains to, "What is my rule?" Thus, the teacher may print on the chalkboard or into the word processor the following: 3, 6, 9, 12. Pupils need to identify what the rule is in writing these numbers. More complex rules may be written as the need arises for older pupils as well for the talented/gifted. A calculator may also be used when readiness is in evidence. Modern technology should be experienced by <u>all</u> pupils when the necessary background skills and abilities have been developed. There are excellent software packages such as drill and practice, tutorial, simulation, and games which might benefit all learners depending upon their previous experiences in using personal computers. Schools need to keep up with society in the use of computers. Mathematics, as one curriculum area, can provide pupils with opportunities to use computers flexibly when the need arises in school and in society. Pupils presently as well as in the future at the workplace need to become proficient in using technology fully. Computer use has made it easier for pupils to write word problems as well as to do and check diverse computations, such as in long division (Ediger, 1997).

Everybody Participates

Sometimes, it seems that only a few can participate at a given time in a discussion in mathematics. It is good to have as many participate actively as possible. Mathematics teachers need to think of ways whereby all may participate. They might write on the chalkboard or type into the computer, addition number pairs such as the following: 15=32= 47, as an example. If the answer is correct, pupils show by raised hand or with a thumbs up signal. If incorrect, no response may be made or a thumbs down signal may be shown. In this way, the mathematics teacher may quickly spot which pupils responded correctly or incorrectly as well as those who watch how others will respond.

The same responses may be made if the number of dots shown on the chalkboard is greater than or less than a certain number. For example, if the number of asterisks is the following inside a circle: {* * * * * * * * * * *} with pupils being asked if this is more than eight, a thumbs up approach should be used. If less than eight, a thumbs down signal should be used. The examples given may be more complex or easier, depending on an appropriate achievement level of pupils involved. Place value can be taught here in that pupils may trade ten of the eleven asterisks for a set of ten to be shown on a place value chart with one slip of paper in the tens column and one slip of paper in the ones column.

The flannel board may also be used also to show cutouts thereon of how many members in a set. Thus, if twelve felt cutouts of bears are shown, pupils are asked to indicate thumbs up or thumbs down if this is more than or less than ten. The twelve felt cutouts may be represented on the place value chart as having one ten (one strip of paper in the tens column) and two strips in the one's column. When ready, pupils may show the twelve cutout bears in the following arrays:
two by six, six by two, three by four, four by three, one by twelve, and twelve by one. Here, pupils, not only are learning multiplication, but also the commutative property of multiplication, as well as factoring (See Ediger, 1996).

Using Transparencies

The teacher may face pupils directly when using the overhead projector with the use of transparencies. With the projection showing on the wall, the teacher may use transparencies that harmonize with the objectives of the ongoing lesson and unit of study. If pupils are studying seven plus five equals twelve, the teacher may place seven transparent circles on the transparency together with another set of five

circles. Here, learners may determine the value of 7+5. The set may be rearranged as 5+7= to indicate the commutative property of addition. The sum of twelve might then be shown on the place value chart with one slip of paper in the tens column and two slips of paper in the ones column.

Diverse kinds of materials should be used in teaching to vary experiences for learners. Application needs to be made frequently of what has been learned by pupils. Here, pupils apply what has been acquired by placing strips of paper properly in the ten's and one's columns on the place value chart.

Films, Filmstrips, and Slides

There are educators who might say that these three devices are outdated in teaching and have been replaced by videotapes. I respond with the idea that the teacher look to see what t kind of content is on the film, filmstrip, and set of slides. I have seen an excellent film, when supervising student teachers in the public schools, that did an outstanding job of having pupils learn to differentiate cubes, rectangular solids, cylinders, spheres, cones, and hemispheres. The objects and drawings of these geometrical solids were clear with a pleasant voice explaining the differences involved.

I also observed a student teacher, whom I supervised, using a filmstrip and accompanying cassette tape to explain how to find the area of the following:

1. a square and a rectangle
2. a right triangle and a circle

Too much content was covered in the filmstrip, but there was unusual clarity in the discussions pertaining to determining area. I suggest the teacher fill in with additional content and discussions when the quality filmstrip attempts to cover too much content in a short sequence of frames. The teacher then needs to use more examples of finding the area of a square, of a rectangular, of a triangle, and of a circle. To understand finding the area of a circle, for example, takes time with many examples needed to show the value and meaning of "radius," "radius squared," and "pi".

I also observed a student teacher use a set of slides to show the concept of equivalent fractions. The student teacher narrated her own slides shown. Several frames showed meaningfully how one/half and two/fourths are equivalent. Thus, two fourths were placed over the one/half to assist learners in clarity of the concept being taught.

An advantage of using filmstrips and slides in teaching is that the

content is still and does not move when teaching from a frame. Also, the teacher may spend as much time as needed to have pupils attach necessary meanings to content taught from one frame before moving on to the next frame. Some of the student teachers and cooperating teachers, I have supervised, have made their own filmstrips and slides to fit into the sequence of content being taught. One filmstrip contained sequential content on adding unit fractions. Here, pupils with teacher explanation understood how the denominators need to be alike before adding unit fractions. For example, in adding one/third and one/half, pupils realized the necessity of changing the one/third to two/sixths and the one/half to three/sixths when using "card board piazzas." Thus, two/sixths and three/sixths were joined together to make five/sixths of a piazza. As readiness, pupils had studied adding one/third plus one/third of the "cardboard piazza" making for two/thirds.

Another student teacher and cooperating teacher made a series of slides on finding the area of squares and rectangles. Each slide was clear on why the length times the width equaled the area in square units. Concrete materials were also used in showing how to find the area of a square and of a rectangle (See Ediger, 134-135).

Using a Geoboard

A geoboard may be made readily and used in teaching geometry. An eight inch square piece of plywood may be obtained. Shingle nails need to be driven in far enough into the plywood so the nails are solidly stationed. The shingle nails should make for one inch squares when driven into the plywood. Pupils may use a rubber band encircling the necessary nails in making the desired geometrical figure to show a triangle, square or other geometrical figure.

The mathematics teacher may show to pupils a geometrical figure such as a square by stretching a rubber band around four nails. The square may be used, among other material of instruction, to have learners identify a square. Pupils may make a square on the geoboard when asked to by the teacher to show that they can differentiate a square form among other geometrical figures. Learners might also make squares from different colors of construction paper.

Estimating in the Mathematics Curriculum

Being able to estimate well is very important to pupils since many things are estimated by individuals in society. Pupils may estimate the distance between the teacher's desk and the end of the room. After estimating, learners collectively or individually may check their estimations. There are so many things that pupils may estimate in the classroom and then check the estimation:

1. how many peas go into a bottle.
2. how many cupfuls are in a pint.
3. how many eggs go into a carton which has room for a dozen.
4. how many teaspoons make for a tablespoon.
5. how many ounces make for a pound.
6. how many square feet in the classroom.
7. how many square inches on a desktop.
8. how many many quarts in a gallon.
9. how many pecks in a bushel.
10. how many objects make a gross.

The use of real objects is important in each of the ten above named items. For example, in number two above, pupils may measure using water showing the number of cupfuls that make for a pint. It is important to make an educated guess first and then measure to determine the correct answer.

Using Money

Pupils need to become proficient in the use of counting money. Practical application needs to be made of money when possible. Thus, a model grocery store may have empty containers ad wrappers from cereal, soap, sugar, candy, and fruits/vegetables. On each item a price needs to be listed. I would suggest using the prices of values being studied presently in mathematics. If pupils are studying addition facts such as 5+3=8, 6+2=8, 9+3+12, and 8+4=12, among others in addition families, then related prices may be put on each container or wrapper, such as eight cents on a container of fruit. The teacher may explain to pupils that this is not the actual price presently in grocery stores, but these values are used by pupils now in the mathematics curriculum. Each pupil may then shop for two items and add the cost. Actual money such as a dime may be used to pay for two items costing 7+3 cents respectively. Pupils may also learn to make change if this is needed from the purchase of two items. Calculators and computers may be used in developing the total for items purchased.

When pupils are ready, they may estimate and "buy" items from a sales catalog displayed in the classroom. Estimating costs may be very valuable here, If a coat costs $53.95 and a pair of shoes cost $55.19, the first value may be rounded to the nearest dollar as could the second value. Thus, $53.95 would rounded off to $54 and $55.19 would round off to $55. Now $54 plus $55 is much easier to total in an estimation. Pupils need to learn the rules for rounding off. If any one place value column has a value of five or higher, the rounding off is made to the nearest next higher value such as $53.95 to the nearest dollar is $54

since nine in the tenths column is 5 or higher in value and the next highest value is 4 in $54. Rounding off is very useful in making many estimations.

One of the student teachers together with the cooperating teachers whom I supervised in the public schools had pupils use an order form to "order" $200 of merchandise from the above named catalog. The order had to come as close as possible to $200 in value. Pupils individually or in committees, as they desired, discussed items of merchandise carefully and worked hard to come up with a final order. Check blanks were duplicated. Pupils could then fill in the correct amount of the purchase on the duplicated check blank.

Flash Cards and Drill/Practice Software

As much as possible, pupils should apply what has been learned and thus receive practice on these experiences. However, there are times when pupils just do not remember or recall basic addition, subtraction, multiplication, and division facts without drill and practice. There is time then for pupils to engage in drill and practice activities. These can be quite interesting, especially if a pupil works with another learner. Two to three pupils may check the accuracy of each other when using flash cards to notice achievement on these basic operations on number. Those facts missed can be taken over again by using the flash cards. A variation in using flash cards is to emphasize software in drill and practice. The software, as is true of flash card use, stresses what pupils have been studying in an ongoing lesson or unit of study and yet the basic facts had not been mastered to the point of automatic recall. After drill and practice activities, pupils should have opportunities to use what has been learned. The level of application is very important in the mathematics curriculum. Prior to any drill/practice activity, pupils need to understand content being emphasized. Thus if drill/practice activities stress 5+4=9 using flash cards or software/computer, pupils should have ample opportunities to use the subject matter acquired (Ediger, 1996).

Learning opportunities in drill and practice, as is true of all activities, should be interesting, purposeful,, and provide for individual differences. Never should it be dull and boring. Pupils will not achieve much if activities are uninteresting and uninspiring.The mathematics teacher should work out sequential strategies whereby pupils individually learn as much as possible and learning is encouraged, not stifled.

Drill and practice activities should be

1. purposeful in that there are reasons for pupils to engage in these kinds of activities.
2. use is made of content learned and not drill/practice

emphasized for its own sake.

3. subject matter is understood and meaning attached to what is being experienced.

4. learning opportunities are varied and not the same activity stressed over and over again.

5. retention of content learned is in evidence.

Addition Bingo

Addition bingo can be a fascinating way to learn for many pupils. A bingo card needs to have the answers to a card from a pile drawn by the learner of the game. The bingo card may be drawn having one inch squares with five answers in each row lengthwise and width wise. Each square then contains an answer to a basic addition fact. Thus, the leader draws a 5+6= --- card. A pupil covers the answer "11" if it appears on his /her bingo board. The first pupil that has five answers covered in a row lengthwise/widthwise or diagonally is the winner of the game of addition bingo. The game also lends itself well to using subtraction, multiplication, and division facts.

With the use of games in teaching mathematics, the teacher should use the following guidelines:

1. pupils should achieve vital objectives in mathematics when playing games

2. entertainment should not be emphasized, except if it emphasizes vital mathematics content to be learned.

3 proper sequence in learning opportunities should be in the offing for all pupils.

4. success in learning is a must for each pupil.

5. individual differences among learners needs provision so each may attain optimally.

Finding Missing Digits

When readiness is in evidence with adequate past experiences, pupils may find the missing digits in a carefully prepared exercise. For example, the pupil may determine what number is missing in each of the following:

52+15= 6--, 28+34=6---, --7+23= --0.

Pupils then fill in the correct number where the dotted line is located. Understanding place value is orderly, significant, and salient for all pupils. Performing the four basic operations is important in becoming proficient in calculation and attaching meaning to what has been learned.

The following are additional addition problems:

1. name two numbers whose sum is 56.
2. name two numbers whose sum is greater than 60.
3. name two numbers whose sum ends in 6.
4. name three numbers whose sum is 82.
5. name three number whose sum is 24.

In finding missing numbers, pupils should

1. feel challenge, but not frustration.
2. work together well with others when working collaboratively.
3. be responsible in governing their very own behavior so that continuous progress is possible in mathematics.
4. appraise personal habits of learning to encourage achieving, growing, and developing.
5. engage positively in problem solving situations.

Multiplication by Nine

Pupils may discover an interesting pattern when multiplying by 9 in drill/practice or problem solving situations. They may answer the following:

9 x 1= 9 x 2= 9 x 3= 9x 4= 9 x 5= 9 x 6 = 9 x7=

The correct answer to each of the above may be checked by adding the separate digits which then gives a sum of 9. This would be true for each of the above named multiplication facts in that the separate digits for the answer, when added together, would equal 9. Also, if two or more digits, where a number "9" is used as multiplier and/or multiplicand, are multiplied, the sum of the separate digits in the answer is divisible by 9 with no remainder. Then too, there are many interesting patterns for pupils to observe in mathematics, such as the following, when considering the counting numbers:

1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30
4	8	12	16	20	24	28	32	36	40
5	10	15	20	25	30	35	40	45	50
6	12	18	24	30	36	42	48	54	60
7	14	21	28	35	42	49	56	63	70
8	16	24	32	40	48	56	64	72	80
9	18	27	36	45	54	63	72	81	90
10	20	30	40	50	60	70	80	90	100

When readiness is in evidence, pupils, collaboratively or individually, may make many discoveries by studying the above table. Pupils may then discover how to multiply, and divide, among other things, when using the table. Learning can indeed be very exciting when pupils notice patterns in the mathematics curriculum. I have noticed teachers who, when having pupils perceive patterns, notice things that had not been observed previously in pupil achievement.

The great philosopher Rene Descartes based his philosophy of idealism on the certainty of mathematics with its order and consistency. It does not possess complete order and consistent, but it comes close to doing so. I have put on the chalkboard the following problem for my graduate students to solve:

4+3 x 6+8= X. Approximately half the class came up with the answer "50," whereas the remainder came up with "30." Those who came up with "50' followed thorough with moving consistently from left to right when computing; the rest knew the correct rule of performing the multiplication operation first and then adding the rest of the numbers in any order. There is consistency and order when following rules of which operation to perform first here, such as multiplication.

In looking for patterns, pupils should

1. enjoy looking for patterns in mathematics.
2. make discoveries which are relevant.
3. apply what has been learned in a new situation.
4. use critical and creative thought in discovery learning.
5. show accuracy in work completed in mathematics.

Determining Ratios

Learning about ratios is very useful to pupils in school and in society. If a table is set with one knife, one fork, and one spoon for each of two people. The ratio is one to one for the number of knives, forks, and spoons when comparing the two persons. There is a one to one ratio. If person A being twenty years older than person B, a six year old child, receives three cookies as compared to person B receiving one cookie, the ratio is three to one. When comparing person B to person A, the ratio is one to three. Thus person B receives one/third as many cookies as person A. If person A eats two slices of bread and person B eats one slice of bread, the ratio is two to one.

Pupils enjoy determining ratios with lifelike situations, in particular. There are numerous questions that pupils like to raise such as the following:

1. If person A eats one and one/half slices of bread and person B eats two/thirds of a slice, what is the ratio?

2. If person A eats one/half of a pizza and person B eats one/fourth of the same pizza, what is the ratio?

Proportion is closely related to ratio, as a topic of study. Many pupils have asked what the height of the flagpole is on the local school building. The mathematics teacher, for example, may have pupils speculate on how to determine the height of the flag pole without climbing to the top, an unsafe procedure. Each pupil may estimate the height before proportion is taught to pupils. The mathematics teacher might begin teaching/reviewing ratio when referring to the flagpole. First, pupils may speculate on how this is to be done when thinking of ratio, a previous learning. Pupils might measure the height of a small shed nearby and its corresponding shadow. The height of the flagpole is not known, but the length of the shadow can be measured rather accurately. Now then, the ratio of the height of the shed to its shadow is five feet to three feet, and the length of the flagpole shadow is nine feet. Thus 5/3 is equal to the unknown "x/9." How can we determine the unknown which is the height of the flagpole with a nine foot long shadow? By keeping the values constant, the length of the shadow of the flagpole is 3 times that of the shadow of the shed. with its nine feet long shadow. Thus, the height of the flagpole must be three times higher than the height of the shed. The height of the flagpole then is 15 feet (See Harel and Confrey, 1994).

Pupils should have many experiences with ratio and proportion using practical learning opportunities. These learning opportunities should

1. assist pupils to achieve relevant objectives in mathematics.
2. guide pupils to apply what has been learned.
3. help pupils to work cooperatively with others.
4. develop skills of reasoning and thinking.
5. encourage problem identification and solving.

Percent and Its Use

There are many times when pupils will read about the concept of percent. In store windows, sales are mentioned with a certain percent to be taken off each item to be sold. Or the sale stresses the selling price indicating a certain percent has already been taken off. Thus, pupils should desire to know the original price of the item to be sold. Learning about fractions will always be a prerequisite. For example, a circle divided equally into four parts will indicate each part to be one/fourth of the entire circle. One out of four is equal to twenty-five out of one hundred. In congruent circles, one could put one fourth of one circle over 25 hundredths of another circle to show the two values are congruent. Another way of saying this is 25%. Twenty-five percent means 25 parts considered out of 100. A prerequisite in studying

percents is decimals whereby in the above example 1/4=.25. One of four parts is equal to 25 out of 100 parts. Thus, .25 means twenty-five out of one-hundred. Thus, a suit selling originally for $100 and a 25% discount would involve taking off one/fourth or .25 of that original price. The discount then is $25 which, of course, is found by multiplying $100 times .25. Why multiply the percent of discount times the original price? The discount is 25% of $100. The word "of" means times or multiply. The selling price of the suit is $100-$25 or $75.

To encourage interest in percent, the following may be done:

1. pupils and the teacher may bring in newspaper and newsmagazine articles on sales where percent is mentioned. These articles need to be discussed and the content understood.
2. pupils individually or collectively may work on simulated items, written by learners themselves, whereby discounts are mentioned in the advertisements. Pupils may then determine the selling price when the original price is stated as well as the listed percent of discount is included in the ad.
3. pupils need to attach meaning to each problem involving percent and be able to explain processes inherent in solving discount and selling prices.
4. pupils need to understand why there are sales of items with the involved discounts.
5. pupils need to understand what is involved in advertising such as to develop desires of people to buy, whether the item is needed or not. Later on, pupils will need to learn to live within their budgets or amount of money available for making purchases, involving the use of credit cards.

Drawing to Scale

Pupils need to be able to read information from maps and globes. Information, involving mathematics, to be read includes degrees north and south of the Equator, degrees east and west of the Prime Meridian, the International Date Line, Time Zones, the Tropic of Cancer, and the Tropic of Capricorn, among others. Meaning needs to be attached to each of these concepts. Memorization is not adequate when writing and speaking about equinoxes or latitudes/longitudes. Understudying in depth is important when emphasizing map and globe concepts. Here, the mathematics curriculum and social studies with its map and globe learnings intersect. An integrated curriculum is an end result whereby pupils experience subject matter as being related, not isolated (Ediger, 1997).

The concept of scale is very important for pupils to attach meaning to, since maps and globes are used frequently by adults as well as

increasingly so by children. Real experiences may be brought in for children to pursue in making drawings where a scale is being emphasized. A teacher and her student teacher whom I supervised in the public schools showed pupils a scale drawing of the living room of the former's house. The drawing was neatly done and much effort had gone into making this drawing. Pupils were very curious in the drawing and asked many questions, such as the following:

1. How large is the living room?
2. Why did you make this scale drawing?
3. Might it have been drawn smaller or larger?
4. What scale did you use in doing the drawing?
5. Could we also make a scale drawing, such as of this classroom?

The teacher had the fourth grade pupils measure the length and width of the classroom. The next problem was how do we get the size of the classroom on an eight by eleven inch sheet of paper? Different scales were tried out and each was too large to get the drawing of the classroom on a sheet of paper. The classroom was thirty feet long by thirty feet wide. One inch should equal five feet seemed reasonable to most pupils. Thus, the size of the drawing on the 8x11 inch paper would be six inches by six inches. Some pupils worked individually while others worked collaboratively in doing the scale drawing. One learner worked on a drawing whereby one inch would equal seven feet. A different committee worked separately on a scale drawing in which one inch would equal six feet. The latter made for difficulties in making the drawing since unusual sized fractions needed to be used. Pupils then realized how important it is to use a convenient scale to make the drawing. the scale also has to be large enough so that it covers the entire page.

The National Council Teachers of Mathematics (NCTM, 1989) in their volume Curriculum Standards for School Mathematics listed the following broad objectives for pupils to achieve:

1. learning to value mathematics.
2. becoming confident in their ability to do mathematics.
3. becoming mathematical problem solvers.
4. learning to communicate mathematically.
5. learning to reason mathematically.

Drawing Graphs

Pupils in the early primary grades may experience success in making picture graphs. Thus, the teaching of statistics may begin on the kindergarten level and then progress may be made sequentially

throughout the different levels of schooling, including graduate school. Statistics is useful in society when reading diverse kinds of graphs.

What kind of graph should make for beginning leanings for pupils? I suggest making a picture graph. The different months of the calendar year might be listed on the chalkboard vertically. A picture of each child having a birthday during that month may be placed next to the month of the birthday. The following is an example with x's used instead of the picture of a child who had the birthday:

January----- x x
February---- x x x
March--------x
April----------x x x x
May----------x
June----------x x x x x
July----------x
August------- x x x x x x
September--
October-------x x
November----x
December----x x x x x x x

When glancing at the above graph, pupils can make many observations including

1. Which month had the most birthdays?
2. Which month had the fewest or no birthdays?
3. Which months tied for having the same number of birthdays?

In sequence, pupils then may experience making bar graphs, line graphs, pie or circle graphs. Statistical figures and tables may also be made by pupils when readiness is in evidence.

The NCTM (1989) lists the following standards for kindergarten-grade four elementary school mathematics:

1. The understandings that children already have when they enter school should be valued and built on.
2. The K-4 curriculum should be developmentally appropriate.
3. The quality of content and instruction is far more important than the quantity.
4. Children should build confidence in themselves as mathematics learners.
5. Children should be actively involved in doing mathematics.
6. Children should see how mathematics is applied to other subjects and in daily activities.
7. A broad range of content should be taught.
8. Calculators and computers should be used appropriately as

both computational and instructional tools.

Conclusion

There are numerous learning opportunities for pupils in the elementary school. Teachers need to grow and achieve in using diversity of leaning opportunities developmentally appropriate for pupils. The following are ways for teachers of mathematics to learn about new and different learning opportunities for children to achieve vital objectives:

1. Talk with other teachers on your grade level or other grade levels about what is done to improve mathematics instruction.
2. Attend grade level meetings of teachers and discuss problems in teaching mathematics.
3. Read current literature in teaching mathematics in the elementary school and implement those ideas that would assist pupils to do better in mathematics achievement.
4. Participate in state and national conventions on mathematics instruction. Secure new ideas in instruction pertaining to mathematics.
5. Survey catalogs on materials for teaching mathematics. Talk to the principal about ordering selected materials, necessary in teaching mathematics.

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